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(12) **United States Patent**
Maruyama

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(54) **OBJECTIVE LENS FOR OPTICAL PICK-UP**

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(*) Notice: Under 35 U.S.C. 154(b), the term of this patent shall be extended for 0 days.

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(30) **Foreign Application Priority Data**

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(51) Int. Cl.⁷ **G02B 05/18; G02B 27/44; G02B 03/02**

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(58) Field of Search **359/565, 743, 359/566, 569, 708, 718, 719, 742**

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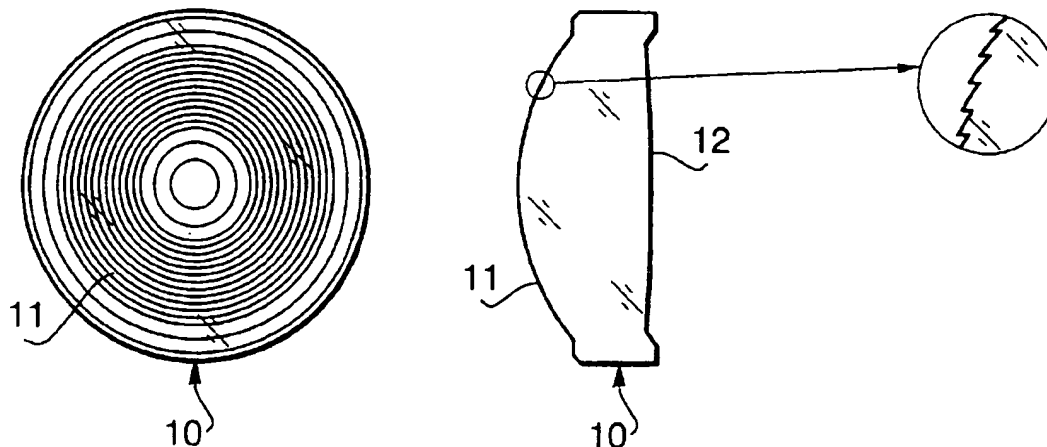
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(57) **ABSTRACT**

An objective lens includes a refractive lens having a positive refractive power, and a diffractive grating having a plurality of concentric ring-shaped steps that are formed on at least one lens surface of the refractive lens. The objective lens is a biconvex plastic lens of which first and second surfaces are aspherical. A diffractive grating is formed on the first surface of the objective lens. The diffractive grating is similar to a Fresnel lens, it is formed as many concentric rings each of which has a wedge sectional shape. The boundary between the adjacent rings is a step to give a predetermined optical path difference. The diffractive grating has wavelength dependence such that spherical aberration varies in the undercorrected direction as wavelength of incident light increases.

7 Claims, 15 Drawing Sheets





US006049519A

United States Patent [19]

Arai et al.

[11] **Patent Number:** 6,049,519[45] **Date of Patent:** Apr. 11, 2000**[54] OPTICAL SYSTEM FOR RECORDING AND REPRODUCING FOR USE IN OPTICAL INFORMATION RECORDING MEDIUM**

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[21] Appl. No.: 09/333,888

[22] Filed: Jun. 15, 1999

Related U.S. Application Data

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[30] Foreign Application Priority Data

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Nov. 28, 1995	[JP]	Japan	7-309189
Dec. 28, 1995	[JP]	Japan	7-352208

[51] Int. Cl.⁷ G11B 7/00

[52] U.S. Cl. 369/112

[58] Field of Search 369/112, 44.23,
369/44.24, 120

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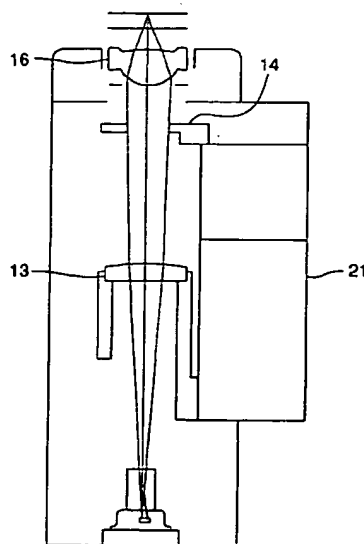
Primary Examiner—Nabil Hindi

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[57] ABSTRACT

An optical system for recording or reproducing of information to or from an optical information recording medium, includes a light source, a coupling lens for converting a diverging light emergent from the light source to a converging light, and an objective lens for further converging the converted converging light and for focusing on an information recording surface of the optical information recording medium. A lateral magnification M_c of the coupling lens on an image side for a light source side and a numerical aperture NA_c on the light source side of the coupling lens satisfy the following expressions respectively, $-7.0 \leq M_c \leq -0.5$ and $0.06 \leq NA_c \leq 0.21$.

13 Claims, 64 Drawing Sheets





US006317276B1

(12) **United States Patent**
Braat

(10) Patent No.: **US 6,317,276 B1**

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(54) **OPTICAL LENS SYSTEM AND SCANNING
DEVICE PROVIDED WITH SUCH A SYSTEM**

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(*) Notice: Subject to any disclaimer, the term of this
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(52) U.S. Cl. **359/785; 359/641**

(58) Field of Search 359/641, 795-796,
359/785, 708, 716-717

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(74) *Attorney, Agent, or Firm*—Michael E. Belk

(57) **ABSTRACT**

In a lens system for focusing a divergent beam in a small spot and comprising a collimator lens and an objective lens, the collimator lens is composed of a positive plastics lens element and a negative glass lens element. This collimator corrects the temperature-dependent spherical aberration of the objective lens. This lens system is very suitable for a scanning device and an apparatus for reading/writing high-density optical discs.

8 Claims, 7 Drawing Sheets

